ENGINEERING EDUCATION

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Chas. F. Scott, Mortimer E. Cooley, F. L. Bishop, *Editor*

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TABLE OF CONTENTS.

President's Letter. Chas. F. Scott, President 164
Three Characteristics of a Good Teacher. F. E. Spaulding 167
Changes in Engineering Courses of Instruction. Frank B. Sanborn .. 170
The Cost of Moving-Picture Instruction. J. H. Pound 175
From the Notebook of an Engineer. III. R. Fleming 184
Report of Membership Committee 191
New Members 193
Sections and Branches 194
College Notes 196
Obituary. Alexander Gray 212
Book Reviews 213

PRESIDENT'S LETTER.

BY CHAS. F. SCOTT,
President of the Society.

"It surprises me that you are having a meeting of this kind; university professors are not usually interested in discussing methods of teaching."

This was the remark of Dr. Spaulding, the new professor of school administration, on the evening of the first meeting of the Yale Branch of the Society, as we met at the foot of the stairs. I acquieseed but remarked that this was a group of engineers. He replied, "Well, they are different."

And it is the more surprising the more one thinks of it.

University faculties exist for two purposes—for teaching and for research. There is a tendency now to emphasize teaching and to assert that a good teacher is entitled to promotion although he is feeble or nil in producing monographs or theses. The research people discuss their subjects and their methods; there is Sigma Xi with its national organization and its local chapters.

Professor Breckenridge, the chairman of the evening, a Yale graduate and for many years a Yale professor, said that so far as he knew this was the first general meeting (aside from departmental conferences) in the history of the institution for the purpose of discussing how to teach.

It is significant that the engineering group was the first to form a national society solely for the promotion of education in its own profession. Its work in the past has been primarily through annual conventions, committees and publications. It is fitting that it should now take the lead in meetings of faculty teachers for the study of teaching. Fortunate it would be if it may perchance set an example to be followed by others.

Conferences between all teachers of engineering students are particularly necessary for several reasons. The engineering course is peculiarly a unit. Its elements are usually prescribed. There are requisites and prerequisites. The proportion of each subject is carefully determined; also its correlation with other subjects in order to make the course a compact unit. There are but few electives. Again, fifty per cent. of the class-hours of the engineering course are taught by non-engineering teachers; English, history, economics, mathematics, chemistry, physics. These non-engineering subjects are the subjects fundamental to engineering. They are the foundation on which the more technical engineering rests. If these subjects are not well taught—if the teachers have not the engineering ideals, if they do not appreciate the type of men their students are to be—the foundation will be inadequate and the superstructure will not rest solidly.

I received word a short time ago that the Society representative in a certain university had asked the dean with reference to the holding of a Branch meeting of the Society and received the reply that there would not be time in October for the proposed meeting but "if later on we could find it possible to coöperate I shall be glad to advise you."

I immediately dictated a reply as follows:

When I was made President of the Society I undertook to determine what was the thing most needed in engineering education which the Society could undertake. I was confronted by a general feeling among the members, in which I had shared, that it was not fulfilling its opportunities and its obligations. After canvassing the whole situation and after obtaining the cordial endorsement from a number of the leading members of the Society, I proposed the plan of branch meetings as one which met a fundamental need by giving opportunity for general and intensive study of our problems by our engineering teachers. I have hoped that the general interest and spirit of our engineering teachers would be such as to welcome such a plan and put it into active operation.

When a leading University does not respond and does not see its way clear to endorse and carry out the plan, I am wondering whether we have made a mistake and whether the whole plan is ill-advised or whether the local conditions are such as to make the intensive consideration of engineering teaching by the engineering staff unnecessary or undesirable.

On second thought I did not send the letter but the foregoing paragraphs are what I would have said if a sense of courtesy or caution had not prevailed.

If we cannot find time to discuss among ourselves the fundamental problem of our profession because there are so many things to do would it not be well to eliminate some of the things we are now doing?

If we do not now see that the profession of teaching engineering really has its problems would it not be well as engineers to survey the situation and find out whether or not teaching is a profession to be cultivated and to determine what its problems are? Certainly those at the Yale Branch meeting learned from the short talk of Professor Spaulding much that was well worth while as it gave new insight and pertinent suggestion to all.

Reverting to the remark of Professor Spaulding, does it not afford material for serious reflection? "University professors are not usually interested in discussing methods of teaching." What other profession or business or industry is there in which the managers or experts are not keen to take up their professional problems with their associates and by discussion and conference and study of methods and results endeavor to determine how their professional work may be better done?

Incidentally, President Hadley after looking over the "Foreword" in the September BULLETIN commented upon the topics contributed by half a dozen members, as follows:

"I am particularly interested in the topics which you suggest for local meetings. It does not seem to me that I have ever seen so well chosen and stimulating a list."

THREE CHARACTERISTICS OF A GOOD TEACHER.

BY F. E. SPAULDING,

Professor of School Administration, Yale University.

1. *A good teacher is a good student.* Something of the spirit and methods of research characterize his work. How is this statement to be reconciled with the prevalent idea that interest in research is often responsible for poor teaching,—an idea that finds support in the remark frequently attributed to college professors, to the effect that were it not for their students, they could make some progress in their profession?

Research directed to the subject matter with which a teacher deals, important as this is in place, especially in advanced grades of instruction, does easily become a menace to good teaching; apparently few teachers are capable of that degree of absorption in research and in teaching which the highest success in either field demands. Most good teachers, so far as they engage in research in their subjects are able to do so primarily only as a means to their one big job, that is, teaching. In the lower grades of instruction, probably also in college grades, one may be an excellent teacher without engaging at all in research, properly so-called, directed toward the subject-matter of instruction.

But whatever the grade of instruction, every good teacher manifests the spirit and attitude of research toward his immediate job—that is, toward his teaching. This job he approaches as an ever new and changing problem. How can he best achieve the objectives that he sets before himself,—objectives in which his students always figure as much more important factors than the subject, whatever it is? This is the good teacher's constant research problem and he should have the attitude and method of research—a definite

aim and objective, a definite plan of seeking it, a method of measuring the results, and the determination of how to do it better next time.

2. *A good teacher teaches his pupils to study effectively the subject of instruction.* Indeed no single concrete aim is more comprehensive or safer for the teacher of advanced pupils than that of helping his pupils to bcome intelligent, discriminating students.

This end cannot be achieved by a single talk or by a few special lessons. It must be a constant determining factor in the work of teacher and pupil.

Good teaching demands the conscious relationship of joint partners, on the part of teacher and pupil; the former is the senior, the latter, the junior partner. These partners are engaged in an intelligent, coöperative effort directed toward definite ends of achievement, which both partners comprehend. They must work together in mutual confidence, the junior partner relying on the superior knowledge, judgment and skill of the senior, the latter relying on the sincerity of purpose and the honest effort of the former to contribute according to his capacity to the achievement of the objectives that both are seeking to attain.

3. *A good teacher assumes a large share of responsibility for the failures of his pupils.* This characteristic is in striking contrast with the pride that some instructors manifest, or simulate, over a large number of failures in their classes. A high percentage of failures, they contend, is evidence of high standards.

High standards of what? Certainly not of success in the joint undertaking in which teacher and pupil are engaged as partners. In this coöperative relation, for the establishment and maintaining of which the good teacher is chiefly responsible, no pupil wants to fail. The desire to succeed is a universal human characteristic. The good teacher confidently relies on this universal desire and skilfully utilizes it, for he knows that the habit of failure is about the worst,

and the habit of genuine success, about the most precious habit that a pupil can form.

In all grades of instruction below the graduate grade, the only failures for which the good teacher assumes no responsibility are the failures due to an actual lack of ability on the part of the student to contribute his part to the joint enterprise. And the good teacher habitually attributes the failure of a pupil to lack of ability, not in the first, but rather in the last instance, and only on adequate evidence.

For failures due to lack of appreciation of the common enterprise, to inexperience in the effective use of his powers, even to distraction and dissipation of effort, on the part of the pupil,—a type of failures usually numerous,—the good teacher feels a keen sense of responsibility. For he regards it as the very heart of his work as a teacher, to make his junior partner appreciate their common task, to teach this junior partner how to apply his powers successfully to the joint enterprise.

No one who is deficient in all three of the above characteristics can hope to be a really good teacher. Anyone whose attitude and work is marked by all three of these characteristics is sure to be an excellent teacher.

CHANGES IN ENGINEERING COURSES OF INSTRUCTION.

BY FRANK B. SANBORN,*

Formerly Professor in Tufts College.

The war changed many of our engineering courses of instruction. There is hardly an engineering school that has not reported since the war some modification of its plans of instruction, and singularly these changes have aimed mainly in one direction—the introduction of practical instruction besides theoretical instruction that was formerly given. Some colleges have added practical courses in shop or field during the college year; others practical courses for the summer vacation; others a whole year of practice before senior year in college. But it is noteworthy that many of the changes involved, in one way or another associate practical with theoretical instruction.

Should this wartime and practical tendency be carried into all of our engineering schools? As a result of seven years in college as a student, I learned to appreciate the interest that can be created in the class-room when a purely theoretical subject is taught by a skilled instructor. (Even an uninteresting subject may be made interesting by a skilled instructor.) I have also had the experience of ten years in engineering practice, eighteen years in college teaching of engineering, five years in research and manufacturing and these years have increased to my estimation the value of practical in association with theoretical, but when I consider the question, can a practical-theoretical course be given that will be suitable for all engineering students, I am skeptical. Some students succeed in a course that combines practical and theoretical, but some need a theoretical training

* 1048 Commonwealth Avenue, Boston, Mass.

first; others need all practical with no theoretical. I believe that colleges should not all attempt to give the same form of course. Each should have a plan that could be definitely defined and does not attempt to suit the needs of every student. Its best plan of education should be selected and formulated in definite terms. Here is the way one college did it and the method may be of value to other colleges.

Circumstances arose at Tufts College just before the war whereby a new president took office. The faculty and the president believed that it was a good time to revise its organization. Accordingly committees were appointed that included under various topics nearly all members of the engineering school. The function of one committee was to develop plans for the future growth of the school. After an investigation of some months it reported a plan which was designated a "vision" and the question arose, after this report, how can a vision be made practicable? In the meantime, another committee had investigated the external relation that the school should have in industry. But this committee found that it was very difficult to make progress in investigations without having clearly in mind what the future policy of the school was to be. It attempted to develop a definite policy and to express it in written form.

The first steps taken were for the purpose of finding the proper place for Tufts in the engineering schools that are located around Boston. It was desired, if possible, to develop a *distinctive* plan and it was believed that by so doing the engineering school at Tufts would be benefited and the general system of education around Boston would be helped if Tufts courses did not run parallel with courses in other colleges as had been the case in previous years. And the committee (Professors Sanborn, Chase, Conner, Rollins and Adams) on this investigation would like to pass a friendly word along to other committees that may be investigating similar questions in other schools, that it is very important to investigate and decide what is going to be the special aim and purpose of any school that is under investigation; what

are other schools covering? How can this particular school fill a distinctive need?

The Tufts plan that was finally chosen after prolonged investigations of methods gives practical instruction in connection with theoretical instruction, but the practical comes just before, not after, the theoretical. Heretofore, the usual method had been followed of giving a few weeks or a term of instruction in theory, and then giving practical illustrations in the laboratory, the shop, or the field. But the new method reverses this order—the practical method comes first, and then the theory. It might take only a few days for the practical, then a few days for theory on that subject, and afterwards more practice and theory on the same part of the subject. Or it might be a whole term of laboratory or field practice and afterwards a whole term of theory. Higher mathematics involving advanced calculus, differential equations were put in the junior or senior years of the courses, and in a few cases as English, French and Spanish only a feeble attempt was made at the beginning to introduce practical methods, although it was believed that later practical instruction could precede theoretical in those courses. The following policy was finally recommended by the committee: (1) that the engineering school at Tufts shall aim to occupy a distinctive field and serve students who are not definitely provided for by existing institutions; (2) that instruction shall have for its basis, as far as practicable, courses involving experience in shop, field and laboratory and out of this experience shall be developed the necessary theoretical training of the course.

A committee may formulate its plans and outline them perfectly but before they become effective they must be approved by the faculty and often that is not an easy step. It was not at Tufts. The older members and leaders of the faculty and some of the officers questioned the wisdom of deviating from the old methods and counseled a waiting period.

The method that the committee used to get the final ap-

proval of the faculty is a method that may properly be used in other institutions where similar questions are being investigated. It consists of first submitting the proposed plan to prominent alumni, engineers, teachers and state officials, obtaining written endorsements and then presenting these endorsements with the signatures of the writers as a part of the committee's report. One of the early graduates of Tufts said concerning the proposed policy for Tufts; "These propositions appear to be educationally sound." A recent graduate endorsed the plan by saying, "I think this scheme is good and I would like to see it in operation," and another said, "I am fully in accord with the proposed plan. It allows the student to deal with the actuality and tends to arouse and facilitate easy analysis which develops concentration. I should be pleased to assist in any way in promoting this movement." Endorsements were obtained from practicing engineers and the following from Professor George F. Swain of Harvard University, "I think the above plan would give Tufts a distinctive field. And if the experience and reasoning are properly coördinated it has much merit." From Mr. Arthur L. Williston, principal of Wentworth Institute, Boston, "I believe that there is without question a most important field for such a school. We have at present too many schools all aiming to cover the same ground and too little individuality among them." Ex-President Charles W. Eliot, of Harvard University, said, "An interesting and promising experiment in technical education and college administration." From the acting superintendent of Massachusetts Board of Education, "An eminently sane proposition bound to draw a large body of students to you who are at present looking for an opportunity. It speaks for service." From Professor C. R. Mann, who was at the time engaged in making his investigation of all engineering schools of the country, "The proposed policy is excellent. It will be a great contribution to the science of teaching to show how the plan may be worked out effectively in practice."

It has been in practice six years at Tufts. At first it formed only the basis for the curriculum of the engineering school. It was taken on trial and emphasized in a few courses, but the plan has gradually grown in favor until it is now used in nearly all courses. The number of students in engineering at Tufts has increased from 200 in 1915 to 400 in 1921.

No other school in the vicinity of Boston at first was following this method of instruction. The plan was distinctive, but during the past year other colleges have modified their courses and introduced changes which have been announced as adaptations of the practical method associated with the theoretical. Should all engineering courses aim in this same direction? Should some colleges give the first two years to instruction in theory—the fundamentals—and the last two years to practical applications? Should others give coöperative education five weeks in school; five weeks in practice, again five weeks in school and so on? Should some become primarily trade schools with little regard for modern languages and literature? Precisely! Why should it not be so? Variety of methods suits the tendencies of many minds. Each school can be more distinctive and the community as a whole will be helped by diversified educational methods. The Tufts method has been distinctive and it has met the demands of an increasing number of students. It appeals to students who like practical first then theoretical, but it is not necessarily suited to the needs of all classes of engineering students.

THE COST OF MOVING-PICTURE INSTRUCTION.

BY J. H. POUND,

Assistant Professor of Mechanical Engineering, Rice Institute.

It is hardly necessary to discuss with teachers the advantages which follow visual methods of instruction. Engineering and scientific teachers especially utilize some of these methods daily, with a full appreciation of the lasting impressions secured through the eye. Sometimes the means used are simple free-hand diagrams on the blackboard. If required often, these become replaced by permanent charts and more formal drawings or perhaps by photographs. For large classes, or where views of actual work are desired, drawings and photographs frequently are turned into lantern slides at a comparatively small cost and with great advantage in the shape of ease of exhibition and discussion, breadth of field from which illustrations can be drawn, and interest excited among students. For the large-scale reproduction of still views, the ordinary stereopticon is probably still our best apparatus; but to illustrate processes, motion is highly desirable. To fit such conditions, the equipment itself or a small model is often displayed on the lecture table, where the adjustments and operations are performed before the eyes of the class. But sometimes the apparatus or process does not permit of introduction into the lecture-room. In such cases, students and instructor must then seek it in the shops or the laboratory or in the field.

Often the demonstration is made under surroundings which make first class explanation or discussion very difficult. As a substitute, the moving picture presents a class-room exhibition which, while lacking in color, odor, and sound, remains sufficiently life-like to make these losses less important than the convenience of demonstration. Many instruc-

tors who have been forced to talk above the noises of construction or plant operation will even call the silence of movement a gain rather than a loss.

Another advantage of the film is its ability to put students in touch with important work which not only cannot be shown in class but which for geographical reasons cannot be reached easily. Many teachers in the south and west feel this disadvantage rather strongly. In these regions, distances between large plants or construction work are often great, and it is sometimes a costly matter for students to become familiar with the large-scale work and industries which are rather commonplace to eastern students. This disadvantage is, of course, one which works both ways to a certain extent. If the southern student cannot easily watch the actual rolling of steel, neither can many others witness the refining of sugar or petroleum. But with the help of films, all these processes can be seen in a lifelike form without leaving the campus. While the writer would by no means suggest the entire substitution of moving pictures for inspection trips, he feels that the films could be made a very useful adjunct to them,—one which would appeal especially to schools in the less thickly settled states.

Unhappily, many of the schools which would profit most by such service are not fortunate in their financial resources. Some are limited both in equipment for demonstration and in access to large or varied engineering work. But the bare necessities for motion picture projection are not more expensive than a small engine or a really nice piece of laboratory equipment, and the projector will permit many more demonstrations than the laboratory apparatus. The total cost depends a great deal on such local conditions as distance of projection, fire regulations, and express charges; but for a small lecture room not requiring a booth or special wiring, the entire first cost might not exceed two hundred and fifty dollars. The operating costs could be confined almost entirely to express charges on the many excellent films loaned gratis.

To rent the projection equipment in Houston would cost from five to eight dollars a day, and a union operator would require six and a quarter dollars more; so for exhibitions of any frequency, it would be much better to secure permanent equipment and to train an operator from among the staff of the school.

Commercial projectors fall into three fairly distinct classes; portable machines which may be folded up and carried like a suitcase; semi-portable machines for medium distance projection which may be knocked down and reassembled in a few minutes; and high-grade professional machines for long-distance projection and permanent installation. Members of the last named class cost somewhere between five hundred dollars and seven hundred dollars installed, and probably are beyond the needs and the pocket-books of many schools.

The suit-case types are always supplied with incandescent lamps varying from one hundred to four hundred watts and arranged for attachment to city lighting circuits, low-voltage generators, or storage batteries. The mechanism is usually motor driven from the same supply. It is designed for mounting on an ordinary table, the weight of the whole apparatus being only eighteen to thirty pounds. The size of lamp being limited, these projectors are suitable only for short distance work, say up to eighty feet, with a picture about eight by ten feet. With short distances and lamps of large wattage, it is sometimes unnecessary to darken the room very much. Several makers claim the ability to stop the film for discussion of a certain picture without danger of burning the film. One maker calls attention to his ability to reproduce stereopticon views on film, with a considerable gain in convenience. There are more than six of these suit-case types well established on the market, at prices ranging from two hundred to two hundred fifty dollars when new.

The semi-portable types are designed to use carbon arc-lights or incandescent lamps of wattages up to a thousand, and are therefore able to project larger pictures over greater distances. The large incandescent lamps cost from three to

five dollars, are expected to average about two hundred hours of service, and eliminate the need for attention to the arc. Most makes of these projectors can be equipped with stereopticon attachments at small cost, making one machine perform the functions of two pieces of equipment at a saving in the total cost of two instruments. The stereopticon feature can usually be put in service almost instantaneously, allowing slides to be shown while films are being changed. There are some half-dozen makes of these projectors on the market, costing from two hundred thirty dollars to three hundred sixty dollars, depending on attachments and make, with an average around three hundred dollars when new. They may be either hand- or motor-driven, the latter attachment increasing the price from thirty to seventy-five dollars. The writer considered the hand-driven machine safer for an inexperienced operator and purchased one of that type; but the motor certainly saves a great deal of work and leaves the operator free to use both hands on adjustments while the film is in motion.

Occasionally a good second-hand projector can be picked up from the moving picture supply houses or through the operators' union at considerably less than the usual price. Some of the supply houses do quite a business in rebuilt machines, guaranteeing them for six months daily service and charging perhaps two thirds of the retail price. Many of these machines are doubtless entirely satisfactory for years of college work.

Since most of the film used at present is printed on standard width (1–3/8″) inflammable stock, the majority of projectors are made to take this film; but if narrow width slow burning film is to be used, machines to suit it are on the market in both portable and semi-portable types.

A suitable screen is another essential part of the equipment. It should not have a glossy surface, which rules out many painted walls; and it should not transmit light, for this would decrease the brightness of the picture. The large professional screens with a metallic finish cost from fifteen to

seventy-five dollars according to size, but very good muslin screens may be had at two thirds of this cost. A large roller window-shade does quite well, and a sheet of white building board mounted on a wooden stand is a convenience when the equipment must be moved from room to room.

In some localities, fire protection equipment will add considerably to the cost of installation. Municipal and state fire regulations must be consulted, and sometimes permits must be secured from the insurance companies. In any case, pains must be taken to minimize the fire and the panic hazards. The danger lies, of course, in the inflammable nature of the film. In most projectors a governor-controlled shutter protects the film at low speeds, but even if this fails to act, special automatic doors prevent the ignition of the film in the sheet-metal magazines. To prove this point, some demonstrators deliberately block the shutter open, allow the heat to burn a film, and show that the reels in their magazines are safe. The chief causes of fire seem to be the vapors liberated by quantities of film in storage or careless handling before inserting in the machine or before rerolling. Smoking near film and storage in a hot place are responsible for many film fires. These, of course, are dangers which can be made small by proper care from the operator. A word about this man will not be out of place.

It is well to realize that school projection need not necessarily be of strictly professional grade. Both the equipment and its normal operation will be comparatively simple. If the film is carefully inspected and repaired before showing, a little practice under the supervision of the salesman-demonstrator should permit a member of the faculty and an intelligent assistant or two to give good shows and make the school independent of outside help. Hired operators are not always satisfactory, even when holding union membership.

Booths are unpleasant things. They are often uncomfortable and unsightly, take up floor-space, and cost money. On the other hand, even a comparatively harmless blaze at

an unscreened projector might start a serious panic. When to omit the booth seems a question of circumstances, assuming that the law does not decide the question in advance. With a good machine, a careful operator, liberal exits, a fireproof building, and mature students, the writer has been willing to assume this risk and has had the consent of the local fire-marshal to do so. In other places, the law would not permit this. The National Fire Protection Association (Boston) publishes a leaflet giving, among other recommendations, specifications for an excellent booth. A local sheet-metal plant quoted a price of two hundred dollars for a one-machine booth made of No. 20 galvanized iron according to these specifications, and a prominent manufacturer of asbestos goods priced a similar semi-portable booth of his design at one hundred seventy-five dollars. Several theatrical supply houses also stock designs. Both booths and classrooms which must be closed tight require attention to their ventilation and cooling systems, especially in summer.

Many of these hazards and difficulties would vanish if the slow burning acetate film were used extensively. Unfortunately, it is not common. It is said that over ninety per cent. of the film used at present is printed on nitro-cellulose stock, a material not approved for use without a booth by the National Electrical Code. Miniature projectors are also not approved by the Code unless designed for slow-burning film of different dimensions than standard. These two restrictions limit seriously the number of projectors and films approved by the Code for use without the booth. A few narrow width projectors are included in the list of Inspected Electrical Appliances of the Underwriters Laboratories. If the school could own its private film library, it might limit itself to narrow width safety film; but at present, it must rely almost entirely on standard width film borrowed or rented from manufacturers, government or educational agencies, or commercial exchanges. Comparatively little of this film is on safety stock.

Of the three sources of supply just mentioned, the first

two are probably both the best equipped and the cheapest, the cost being only transportation charges. Between the three, almost any really important manufacturing or construction process can be located on film somewhere if the teacher will only search for it earnestly enough. It is true that such films will usually be of an advertising character, issued by commercial firms or associations of firms desiring publicity for their industry; but it is seldom that the advertising is done so poorly as to be objectionable. Practically all the large electrical and automobile companies lend films dealing with manufacturing, transportation, or communication problems; most of the manufacturers of steel, pipe, lumber, oil, cement, and clay products do the same in their fields; and the United States Bureaus of Mines, Education, and Agriculture, and the National Safety Council have long lists of films covering mining, power generation, highway construction, safety, and welfare work. Both the Bureau of Commercial Economics (Washington) and the Motion Picture Bureau of the International Committee of Y. M. C. A.'s (New York), act as booking agents for a great number of interesting technical films loaned gratis by manufacturers.

Of the several commercial exchanges for industrial and educational subjects, the *Ford Educational Weekly* is well known. Its rental of single reel subjects is a little over three dollars, plus small express charges, with a rapidly decreasing price for larger numbers of reels, finally reaching about a dollar a reel. Many of the subjects carried by the educational exchanges, while excellent in themselves, are not suited for display to engineering students. The Society for Visual Education (Chicago) and several non-theatrical exchanges are releasing strictly school films, but their subjects seldom fit snugly into engineering curricula.

The work of noting new releases and of selecting, inspecting, and shipping borrowed film requires a certain amount of time from the teacher, but the increased interest and

clarity of understanding which results are worth considerable effort. Considering the work which would otherwise be spent in wrestling with misunderstanding and mental inertia, the pictures may well result in a net gain in time. Moreover, if the projection equipment is readily available, a certain amount of the booking and transportation work can be turned over to the officers of the student engineering societies, who are usually glad to show an occasional film. But both they and the teacher must avoid the temptation to use film as an easy means of filling the lecture schedule, without much regard for the appropriateness of the subject shown.

The idea of supplying films to illustrate definite courses or texts is not a new one. At least one textbook publisher has attempted it, apparently without success. It is more than possible that we shall see such help on the market some day, but at present the cost of special engineering films is high compared to the circulation they would command. A salesman for one motion picture studio, himself once a civil engineer, estimates seven hundred fifty dollars as the cost of a film showing the principles of level and transit work by outdoor views and by diagrams. Indoor work requiring artificial light costs about a dollar and a half, while outdoor work costs about a dollar a foot, salary and expenses of camera-man and director in addition. Animated cartoon work runs from two and a half to five dollars a foot, depending largely on the number of pictures required. Evidently any schools attempting to produce their own film must expect to spend considerable money. They must remember too that some of their material will get out of date rapidly.

A cheaper expedient, possible at least occasionally, suggests itself. Prints made from existing negatives cost only about ten cents a foot, or a hundred dollars for a standard one thousand foot fifteen-minute reel. Could not the school-made film contain prints of selected parts from the manufacturer's advertising film, just as textbooks often include occasional illustrations from trade catalogs? The answer depends

largely on the willingness of the manufacturer to have his film shown minus part of its advertising features and perhaps mixed up with other film furnished by his competitors. Probably many owners would object to this arrangement unless there were keen competition for inclusion in the school film. In any case, the college would be subject to a certain amount of expense. This outlay might possibly be recovered by rentals to other schools, but in this field the commercial films, loaned without rental and perhaps containing a part of the college film, would be dangerous competitors. What can be done with such a plan seems capable of proof only through trial—an experiment which the rapidly increasing number of good advertising films makes more and more feasible. In the meantime, the commercial and public films are the mainstays of those engineering schools using projectors.

As in the case of many other teaching problems, the question of how far the engineering schools can use the moving picture to advantage seems to be largely a matter of the most efficient use of available funds. The special film, made by the school for its own needs, is now too costly for most colleges, but prints from existing negatives are much cheaper; and even if borrowed films alone must be depended upon, the equipment is within the reach of many schools not using it. Effective instruction can never, of course, be given without flesh and blood teachers, working through all five senses; but especially to the engineering lecturer whose work requires repeated demonstrations of those processes or equipments not readily demonstrated in class, the moving picture becomes more and more possible as a valuable assistant. It is a means of technical instruction which will bear watching, with serious adoption as soon as costs permit.

FROM THE NOTEBOOK OF AN ENGINEER. III.

BY R. FLEMING,

American Bridge Co., New York City.

A symposium, "What Department of this Periodical do You Read First," is always interesting. For himself, the writer puts first, "Inquiries from Correspondents," "Questions and Answers," or "Letters to the Editor." From material gathered from such departments the questions and answers following are selected. It is true that many of them, both questions and answers, are trivial, but they serve the purpose of showing how some minds work when approaching a more or less technical question.

In designing a factory floor the law requires a weight of 250 lbs. per square foot to be allowed for. What is the proper way to proceed to design the floor, or to get the proper size of the girders, and the size and spacing of the iron floor beams (I-beams) from this given weight?

The proper way to proceed, if the factory is in Jersey City is, *via* any one of the North River ferries, to the office of any one of a number of civil engineers below Chambers Street, New York. He will design the floor properly, so that it will both be economical *and* stand up under its load. Otherwise there is danger that neither end will be fulfilled. As the above letter reaches us anonymously we could not take notice of it, but in the interest of science and human life give this much advice free.

—*Engineering News*, April 16, 1887.

In answer to a query as to what would happen if his proposed 1,000 ft. tower in Paris should topple over, M. Eiffel said that it was calculated to withstand a wind pressure of 61½ lb. per sq. ft.; counting the lattice work as full surfaces. He further remarked that in the event of a wind of this power sweeping over Paris, little would be left standing there—except the tower.

—*Engineering News*, March 12, 1887.

When no tables are accessible, how would you get the sine of any given angle?

The sine of an angle may be obtained approximately from the following formula, in which a is the length of the arc of the angle corresponding to radius 1:

$$\text{Sine } a = 3.6\,\frac{a}{\pi} - 3.2\left(\frac{a}{\pi}\right)^2.$$

Thus, for instance—as a then is

$$2\pi \times \frac{60^\circ}{360^\circ} = \frac{\pi}{3},$$

the sine of 60° is approximately,

$$3.6 \times \frac{1}{\pi} \times \frac{\pi}{3} - 3.2\left(\frac{1}{\pi} \times \frac{\pi}{3}\right)^2 = 3.6 \times \frac{1}{3} - 3.2\left(\frac{1}{3}\right)^2$$
$$= 0.844 \text{ (correctly } 0.866).$$

The sine of 45° is

$$3.6 \times \frac{1}{\pi} \times \frac{\pi}{4} - 3.2\left(\frac{1}{\pi} \times \frac{\pi}{4}\right)^2$$
$$= 3.6 \times 1/4 - 3.2\,(1/4)^2 = 0.7 \text{ (correctly } 0.707).$$

The sine of 30° is

$$3.6 \times \frac{1}{\pi} \times \frac{\pi}{6} - 3.2\left(\frac{1}{\pi} \times \frac{\pi}{6}\right)^2$$
$$= 0.6 - 0.089 = 0.511 \text{ (correctly } 0.5).$$

—*Home Study Magazine*, Nov., 1897.

I am told that the difference between the length of an arc and its chord at the surface of earth is one foot in 34½ miles. I want the length of the former for a difference of one inch. How am I to calculate it?

I have found the following (approximate?) formula amongst some old notes in Gillespie's "Geodesy." If in a circle of radius r, c is the chord of an arc a,

$$c = a\left(1 - \frac{a^2}{24r^2}\right).$$

Taking the radius of the earth as equal to 3960 miles, the dif-

ference in question by this formula is just 7 inches in an arc of 34½ miles.

—*English Mechanics and World of Science,* Oct. 24, 1919.

What is the estimated life of a steel-frame building and is there any probability, after 300 or 400 years, or even longer, that a building of this kind may suddenly collapse due to the weakening of the steel frame caused by oxidation?

There is little data from which the probable life of the steel frame as employed in buildings of the office type can be even approximated, but it has been determined from buildings of this character erected 20 years, that the corrosion of the steel is extremely slight. It would not be a rash statement to say that the life of such buildings, so far as the steel framework is concerned, would extend considerably over the period of 100 years. It has been found, and especially is it true in this country, that any building other than an ecclesiastical edifice outlives its usefulness in a century, and it is hardly probable that even the magnificent modern office buildings will fulfill the requirements of the locality in which they are placed 100 years from now. That they will be required 300 or 400 years from now is highly improbable.

—*Science and Industry,* August, 1900.

The longevity of a fireproof office building is at present of more than academic interest. Members of the Building Managers' Association of Chicago were asked their opinions for use in a case pending before the Income Tax authorities at Washington. Six directors prepared individual opinions, the consensus of which was that "it is not safe from an investment standpoint to assume that the profitable life of even the best fireproof office building in Chicago will exceed from 30 to 40 years from the date of its construction."

The *Bulletin* of the Association (November, 1920) lists seven once prominent office buildings that were removed (with two exceptions) after lives of less than 30 years to make way for more "modern" buildings. What is happening in Chicago will probably be experienced elsewhere. It is not because of physical deterioration that a many-storied office building is torn down. Increased ground values, meaning higher taxes,

and the attractions of the improved equipment of newer buildings often necessitate its being replaced by a building more "up to date" and usually with more stories.

I have heard it said that a dog *trotting* across a steel bridge (provided there is no other object moving on the bridge at the same time) is liable to wreck the bridge. Is this so? . . . I understand that it is the regular movement or action of the dog's *trot* that starts the bridge swinging, and finally wrecks it.

Synchronized vibrations will shatter almost anything. It has been demonstrated that if the correct pitch is known, a tone from a violin will shatter a glass goblet. . . . When a dog trots over a bridge which is otherwise empty it imparts a series of shocks to the bridge which are exactly timed. The succession of the shocks, each in itself extremely small, sets up a series of vibrations in the bridge which are naturally accumulative. If you were to deal with the matter theoretically and assume an infinitely long bridge, the vibrations set up by the trot of the dog would, at some point, reach a magnitude which would wreck the bridge. Practically, of course, no such results are possible. We have personally seen very decided vibrations set up in a bridge by a dog trotting over it.

—*Scientific American*, July 1, 1916.

How many cubic feet should be allowed for a ton of coal?

To be on the safe side, provision for storage of coal should allow not less than about 40 cu. ft. per ton of 2000 pounds and 45 cu. ft. per ton of 2240 pounds.

—*Power*, Feb. 12, 1918.

How many kinds of riveted joints are used in boiler work and what is the effective strength of each compared with the solid part of the boiler plate?

The different kinds of boiler joints and their approximate efficiencies, as usually designed in good joints, are as follows:

Lap-joint, single-riveted, longitudinal or girth	57%
Lap-joint, double-riveted, longitudinal or girth	74%
Butt and double-strap joint, double-riveted	82%
Butt and double-strap joint, triple-riveted	87%
Butt and double-strap joint, quadruple-riveted	93%

—*Power*, July 23, 1912.

Please give formula for finding the stress in a rectangular

plate when supported and restrained upon all sides. Give formula for a square plate under similar conditions. If possible show how the formulas are obtained.

No one has as yet derived formulas for the stress in plates under these conditions, the mathematical analysis being so difficult as to allow of no approximations that would have any practical value.

—*Home Study for Machinists,* Jan., 1899.

In contrast to the answer given to the last query see Johnson's "Materials of Construction Rewritten." Under "Approximate Determination of the Strength of Flat Plates under Normal Forces" are given equations answering the questions asked.

Questions as,

> What is the meaning of the term, circular mil?
> What is meant by absolute temperature?
> What is latent heat?
> What is the modulus of elasticity?

are asked again and again. To the technical reader it may seem that they could easily be answered by reference to a dictionary or a textbook. But it should be remembered that the questioner may not know to what book to turn or if he knew might not have access to the book. The answers given to such questions are often worth repeating. One question and answer will be quoted.

In an old textbook on mechanics I frequently encounter the expression "principle of virtual velocities." . . . Will you please explain it?

The simplest statement of the law of virtual velocities is: The power multiplied by the distance through which it moves equals the weight multiplied by the distance through which it moves. Here the word "power" means the acting force, and the law applies to all machines. The reason for using the word velocity instead of displacement (which is a better term) is that the older writers considered the time involved in the movement; but since the time the weight is moving is exactly equal to the time the power is acting, the time may be made unity and neglected, thus leaving the law as stated.

—*Machinery,* June, 1916.

A question often asked and which invariably brings a protest to the answer given is some form of,

Is it true that if a peach twig with a Y shape is inverted and carried over the ground it will revert to the opposite position at all points where water may be found in quantities sufficient for a well?

The answer that was given in this particular instance is too long for quotation. It conformed to the opinion of men with even an inkling of scientific knowledge that there is absolutely no scientific reason why any action such as that mentioned should take place, and the results, if any were obtained, were due to purely psychological reasons.

The myth has been controverted for centuries. The Encyclopaedia Britannica devotes a page to the divining rod. From far Honolulu comes the bulletin of the Hawaiian Engineering Association, July, 1916, bearing the title, "A Hypothesis Regarding the Use of the Divining-Rod in Locating Underground Water." In 1917 the U. S. Geological Survey issued "The Divining Rod, A History of Water Witching with a Bibliography," by Arthur J. Ellis, a bulletin of 60 pages. Of these, 28 closely printed pages are given to the bibliography. Each year adds to the astonishing number of articles, pamphlets and books already written on the subject. Why they should so readily obtain a hearing is a mystery, but the human kind likes the mysterious.

The oscillation of chimneys and high buildings during severe winds is a matter of interest. The following is from *Power*, Dec. 5, 1911.

Do not brick and cement chimneys oscillate in high winds? How much out of center would the top of a well-constructed chimney, 125 feet high, lean in a 60-miles-an-hour wind?

All chimneys oscillate in a wind. It is practically impossible to state what the oscillation would be in the case presented. The factors which influence the oscillation of a brick chimney are its diameter, the taper of its sides, the material and workmanship and the rate at which the wind is blowing. Assuming a chimney of 125 feet in height and 60 inches in diameter with a 2 per cent. taper and built with fairly good care and material,

the oscillation in a 60-miles-an-hour wind should be about 2 inches either side of the true center line.

Careful observation made by Professor Omori on the Saganoseki, Japan, reinforced concrete chimney of 570 ft. height and 26 ft. diameter showed at the top an amplitude of vibration of less than 1 in. for winds of 50 miles an hour though it reached 7.32 in. for a wind of 78 miles an hour.

For a choice bit of nonsense the following, taken from a New York daily, does very well.

The answer to the query "Do Skyscrapers Wobble?" is, all well built towers sway in response to wind or jars. The top of Trinity steeple sways about eighteen inches every time an elevated train passes. St. Paul's steeple swings much more than this. Washington Monument sways four or five feet in a heavy wind, the Woolworth Building seven or eight feet.

Tenants of the Woolworth building need not worry, but why are non-technical men so ready to express opinions on technical subjects?

MEMBERSHIP COMMITTEE.

By the action of the Council a membership committee was organized by President Scott under the direction of Dean A. A. Potter as Chairman. The country was divided into five districts with a chairman in each district.

The general reasons for membership are set forth in the "Information" pamphlet and special reasons why non-engineering teachers should be members, are given in a series of short articles in the October number of ENGINEERING EDUCATION.

The establishment of Branches in different institutions gives an added value of the Society to its members. It is not intended, however, that these meetings are solely for members as they are open to all interested who should feel free to participate by presentation of papers and discussions.

District No. 1.—Chairman, H. S. Boardman. States of Connecticut, Maine, Massachusetts, New Jersey, New Hampshire, New York, Rhode Island and Vermont, China, Australia, Turkey, Japan, England and India.

District No. 2.—T. E. French, Chairman. States of Pennsylvania, Ohio and Michigan.

District No. 3.—A. C. Lanier, Chairman. States of Alabama, Arkansas, District of Columbia, Delaware, Cuba, Florida, Georgia, Kentucky, Louisiana, Maryland, Missouri, Mississippi, Oklahoma, Tennessee, Virginia, West Virginia, North Carolina, South Carolina and Canada.

District No. 4.—G. R. Chatburn, Chairman. States of Iowa, Colorado, Kansas, Minnesota, Wisconsin, Nebraska, North Dakota, South Dakota, Indiana and Illinois.

District No. 5.—R. L. Daugherty, Chairman. States of Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington and Wyoming.

There have been 125 members appointed on local membership committees. On December 7 we had received 65 appli-

cations, 7 of which are institutional members, and 3 reinstatements. We have had 51 resignations. Approximately 2,200 information booklets have been sent out. Five hundred and thirty-one copies of the October number of ENGINEERING EDUCATION were distributed. One hundred reprints of President Scott's Foreword in the September number were sent to presidents of engineering schools in this country and Canada.

NEW MEMBERS.

BOSTON, ORLAN W., Assistant Professor of Shop Practice, University of Michigan, Ann Arbor, Mich.

BOYLE, WALTER W., Assistant Professor of Mechanical Engineering, University of Pittsburgh, Pittsburgh, Pa.

HOWES, HORACE L., Professor of Physics, New Hampshire State College, Durham, N. H.

MCGREGOR, HOWARD L., Assistant President, National Twist Drill & Tool Co., Detroit, Mich.

MILLS, JOHN, Assistant Personnel Manager, Eng. Dept., Western Electric Co., Inc., New York City.

PLANK, WILLIAM B., Head, Dept. Mining Engineering, Lafayette College, Easton, Pa.

STARR, CHARLES J., Assistant Supt. Machine Laboratory, University of Illinois, Urbana, Ill.

WALKER, HARRY B., Professor of Agricultural Engineering, Kansas State Agricultural College, Manhattan, Kans.

WEBBER, W. PAUL, Professor of Mathematics, University of Pittsburgh, Pittsburgh, Pa.

WHEELER, NATHANIEL E., Professor of Physics, Colby College, Waterville, Maine.

YOUNG, E. G., Mechanical Engineering, Chiao Tung University, Shanghai, China.

SECTIONS AND BRANCHES.

President Scott inaugurated the movement for the establishment of branch meetings of the Society in order that the Society might be of more immediate value to its members. In the September number of ENGINEERING EDUCATION he outlined the plan for such meetings. In the opinion of the Secretary this request of President Scott has met with a most remarkable response.

The Secretary has received reports from a number of institutions where such meetings have been held. He addressed a circular to the representatives in 92 engineering schools on November 26 asking for definite information in regard to whether such meetings had been held or were contemplated and if no meetings were to be held, the reason. A synopsis of the replies indicates that meetings have already been held in 15 institutions; of these meetings three were sectional meetings which included representatives from one or more institutions as for instance the meeting of the New England Section held at the University of Maine. Ten institutions have reported that plans are under way for holding meetings; twelve report that no meetings would be held. The reasons for not holding meetings are such as you would expect. In many of the smaller institutions the faculty meets weekly and has ample time for the discussion of various problems. At other institutions meetings have been held of the American Association of University Professors at which educational topics of somewhat similar character are discussed. At one larger engineering school the institutional representative states that "this place is practically overburdened with organizations and there does not seem to be any good reason for adding to the list. Apparently nothing would be accomplished by the formation of such a branch that is not being accomplished by other agencies."

Wherever the meetings have been held the reports indi-

cate great enthusiasm in regard to teaching. Practically all the problems which have been considered at these branch meetings have dealt specifically with methods of teaching rather than with the subject matter of the curriculum. By including representatives from the non-technical faculties a better mutual understanding of the problems confronting the engineering educator has been brought about.

In other words, twenty-seven per cent. of the engineering schools have organized branches and are thus co-operating with each other, through this Society, in the development of better teaching.

COLLEGE NOTES.

Armour Institute of Technology.—New members of the faculty of the Armour Institute of Technology for the year 1921–22 are: H. J. Kesner, associate professor of civil engineering; R. J. Foster, instructor in descriptive geometry; R. T. Nelson, instructor in actuarial science; W. B. Amsbary, lecturer in general literature; F. C. Lusk, lecturer in business law.

The Institute was honored at the annual meeting of the Fire Underwriters Association of the Northwest, held at the Congress Hotel, Chicago, October 5, by the gift of a large bronze tablet in commemoration of the eminent service rendered in the cause of fire prevention by the late president, Dr. Frank W. Gunsaulus.

The interest in fire prevention shown by Dr. Gunsaulus in 1903, when a union committee on fire protection called on him, resulted in the establishment of the present Department of Fire Protection Engineering at the Institute, and laid the foundation for the only complete engineering course of its kind offered in any institution of the country.

Fire insurance organizations have evidenced their interest in this work at the Institute through the coöperation of the Underwriters Laboratories, Chicago, and the establishment of twenty-five scholarships awarded each year by a committee of insurance representatives for the duration of the four-year course.

University of Illinois.—Hardy Cross has been appointed professor of structural engineering; Clyde B. Pyle, assistant professor of structural engineering; C. K. Mathews, instructor in civil engineering; Walter Thomson Morrow, instructor in structural engineering; Cornelius S. Bullions, instructor in electrical engineering; Charles Alva Keener, instructor

in electrical engineering; Trice Morton Bell, assistant in electrical engineering; Edward Everett Perkins, assistant in electrical engineering; Edward Pugh Price, assistant in electrical engineering; Ralph S. Crossman, instructor in general engineering drawing; Adelbert Diefendorf, instructor in general engineering drawing; Allen I. Dunn, instructor in general engineering drawing; William J. Farrisee, instructor in general engineering drawing; Olen Edgar May, part-time student assistant in general engineering drawing; William H. Severns, assistant professor of mechanical engineering; E. J. Crane, instructor in mechanical engineering; William Harris Foxwell, assistant in mechanical engineering; Frank C. Linn, assistant in mechanical engineering; John Dallas Wise, superintendent of the foundry laboratory; Russell James Englehart, assistant superintendent of the forge laboratory; Cloyde Moffett Smith, assistant in mining engineering; William Ruprecht Osgood, instructor in theoretical and applied mechanics; William Parkerson, assistant in physics; Kenneth Orville Smith, part-time assistant in physics; G. E. Van Lone, part-time assistant in physics; Edward Charles Schmidt, professor of railway engineering and head of the department; Arthur Joseph Hoskin, research assistant professor of mining engineering; Thomas McLean Jasper, special research assistant professor of engineering materials on the investigation of the fatigue phenomena of metals; Joseph T. Tykociner, research assistant professor of electrical engineering; Rex Lenoi Brown, research assistant in theoretical and applied mechanics; Floyd B. Hobart, research assistant in chemical engineering; George Theodore Felbeck, research assistant in mechanical engineering; Crandall Zachariah Rosecrans, research assistant in mechanical engineering; Norman Boynton Green, research graduate assistant in theoretical and applied mechanics; George Toel Lorance, research graduate assistant in physics; Koppel Schapiro, research graduate assistant in

civil engineering; Otis Gayle Stewart, research graduate assistant in mining engineering.

The University of Kansas.—FACULTY APPOINTMENTS.

William C. McNown, since 1913 a member of the civil engineering staff as assistant and associate professor, has been advanced to a full professorship in highway engineering.

F. Ellis Johnson, since 1915 associate professor in the department of electrical engineering, has been advanced to the rank of professor, second in the department.

Jacob O. Jones, B.S. in Civil Engineering, Kansas, 1912; M.C.E., Cornell, 1915, since 1915 assistant professor of hydraulics, has been advanced to the grade of associate professor of hydraulics and hydraulic engineering. Professor Jones has had several years of professional practice in general civil engineering lines including irrigation and drainage work.

Edward D. Kinney, a graduate of Harvard in 1907, has been appointed associate professor of metallurgy. Professor Kinney has had many years of experience in the metallurgical field, in which he has been associated with the Anaconda and other representative companies. This is his first move in the educational line.

Andrew M. Ockerblad has been appointed assistant professor of civil engineering.

Ernest Boyce will assume teaching duties in the second semester of the current year as Asst. Prof. of Civil Engineering.

Warren R. Neuman, for the past two years an instructor in electrical engineering, has been advanced to an assistant professorship.

N. E. Wiedemann, for the past year an instructor, has been advanced to the grade of assistant professor of architecture.

Robert W. Warner has been appointed instructor in electrical engineering. For the past three years he has been in

the employ of electrical utility companies in Denver and Topeka.

John W. Bunn has been appointed instructor in industrial engineering, and research assistant in mechanical engineering subjects.

Paul S. Fox has been appointed instructor in civil engineering for a half year.

Contract has been let recently for the construction of the new electrical laboratory provided for by legislative appropriation at the last session. This is to be a new unit added to those now provided for mechanical engineering and hydraulics laboratories. It is a stone structure costing $40,000, designed to provide space for laboratories, computing rooms, storage, and a repair shop for the service of all laboratories in the engineering group.

The teaching of English to technical students has taken on a more distinctive character. This is reflected in the organization of the English staff, which now includes four full-time instructors for the engineering students alone. Three of these are men, two of whom have had some experience or direct contact with technical work. Two instructors are new this year, Victor Solberg and Max. B. Jaslow.

Requirements in English composition applying to all candidates for degrees in engineering include eight hours—five in the freshman year and three in the junior or senior year. The department offers three additional optional hours in writing of technical articles. In addition there is a requirement for the preparation by each student of two or more technical reports during semesters when he is not enrolled for formal class work in English. While this is done under the supervision of members of the technical department staffs, it is in reality a part of the training in composition.

The University of Maine began its new year September 13, with a registration of 1,453. The entering class num-

bered 464, 204 being registered in the College of Technology. The total registration is distributed as follows:

College of Arts and Sciences	604
College of Agriculture	292
College of Technology	530
Graduate Students	27

During the summer, Dr. R. J. Aley, who has served as president of the University since 1910, resigned and went to Butler College, Indiana. It is quite likely that no successor will be chosen during the present college year. The institution is now being administered by the Administrative Committee, composed of the four deans of the institution. This committee has been in existence for many years, and previously had as its chairman the president of the University. All financial matters and matters other than educational which are not of a routine nature are taken up by a joint committee which meets every two weeks, consisting of the executive committee of the board of trustees and the deans. This method of administration so far has proved a success.

On October 15 the University entertained the New England Section of the Society for the Promotion of Engineering Education. The subject for discussion was "The Teaching of Physics in Technical Schools," and was in charge of Professor W. S. Franklin, of M. I. T.

The University of Maryland.—The College of Engineering, which includes the departments of civil, electrical and mechanical engineering, has just undergone a reorganization. The general purpose was to broaden the courses of instruction the better to prepare young men to enter the public service, which training seems preëminently a function of the State's university. It was not the intention that the subject matter of the courses should be essentially different from that usually given, but that the viewpoint of the student

and the application of the principles will be that of public service.

Beginning with this academic year all freshmen and all sophomores, respectively, in the College of Engineering, take the same courses of study, thus postponing until the commencement of their junior year specializing in one of the three branches of engineering.

The Engineering Experiment Station, being conducted in coöperation between the U. S. Bureau of Public Roads and the State Roads Commission of Maryland, is now well under way. Some important problems in the field of highway research are being studied and it is expected that results of value will be available shortly.

The University of Nebraska.—The last session of the Nebraska legislature appropriated money to inaugurate a trade school under the direction of the University. The school was opened October 3. Courses ranging from three months to two years are to be given. At present they will include instruction in agriculture—not the general agricultural course, but in special lines such as practical dairying, poultry, hog, cattle and sheep raising—auto mechanics, blacksmithing, carpentry, dental mechanics, electrical trades—such as linemen, telephone repairers—machinist trades, pattern making, plumbing, printing, and tractor operation, as there seems to be a demand for the same. Dean Burnett is in charge of the trades relating to agriculture and animal husbandry; Dean Ferguson, those pertaining to mechanics; Dean Davis the dental work; and Dean Buck, printing.

It is thought that a number of ex-soldiers will take advantage of this opportunity to secure the fundamentals of a trade. There will also be sent to the school for instruction laborers who have been injured in their regular lines of work providing the State Commissioner of Labor thinks they will benefit thereby. The legislature has given the Commissioner authority to expend a certain sum for the

education of these men. The school, however, is to be open to all and not confined to these classes.

Tuition in the school will be charged the same as in other departments. This is nominal and not expected to cover the entire cost of the school. A student will be allowed to register only for one of the trades offered. At first he will spend about two thirds of his time in the laboratory doing practical work and receiving practical instruction. Later he will be registered in some academic subjects related to his course. Four school terms in each year is contemplated, three terms of three months each and a short summer term of two months.

State University of Oklahoma.—A course in the measurement, compression and transmission of gas in pipe lines has been developed during the past year. The course deals with the means of making measurements both approximate and accurate, the compression of gas by means of one or more stages, the use of vacuum pumps, and the flow of gas in pipe lines of simple and complex nature.

Apparatus is being installed which will facilitate the teaching of the course by adding some laboratory work.

Oregon Agricultural College.—The present college year opens under auspicious circumstances and with a bright outlook for the future. Attendance in the school of engineering exceeds that of last year by about fourteen per cent. The spirit of unrest among students following the World War has disappeared and both students and faculty are enthusiastic in their work.

Among additions to the teaching staff are John R. DuPriest, associate professor of mechanical engineering and Stanley R. Cummings, assistant professor of mechanical engineering.

The former is a graduate of Cornell University; for the past three years, consulting engineer for the Ellicott Machine Corporation of Baltimore, Md. He also has a record

of successful teaching experience in Sibley College, at the University of Wisconsin, at the University of Idaho, and at Rensselaer Polytechnic Institute.

Mr. Cummings is a graduate of Massachusetts Institute of Technology, and comes to us from that institution where he was instructor in the mechanical engineering laboratory.

Oregon Agricultural College—Civil Engineering Department.—Due to a large increase in student enrollment since 1919 and to a reorganization of departments in the Engineering School of the Oregon State Agricultural College many changes in the curriculum and additions to the staff of the civil engineering department have been made.

In 1919 Stuart H. Sims was appointed professor and head of civil engineering. Professor Sims, who is a graduate in civil engineering of the University of Michigan, came to the Oregon State Agricultural College with an experience of seven years in engineering education, principally obtained at the University of Iowa, where he also did graduate work in education, and with twelve years' experience in engineering and business.

The appointments of Messrs. Burdette Glenn and I. F. Waterman as instructors in civil engineering were also made in 1919. Mr. Glenn, previous to his appointment, had been a student instructor at the University of Michigan. Mr. Waterman has done graduate work at the University of Wisconsin and has taught engineering at the John B. Stetson University in Florida.

During the summer of 1920 the department of irrigation engineering, which together with the department of highway engineering had been distinct from the department of civil engineering, was incorporated into the department of civil engineering. Mr. Samuel M. P. Dolan, who had been assistant professor of civil engineering, was promoted to associate professor; Mr. D. R. Smith who had been instructor was promoted to assistant professor; Mr. John Dubuis who had been instructor in irrigation engineering was promoted

to assistant professor of civil engineering. Mr. I. F. Waterman was transferred to the department of mechanics and materials. Mr. H. S. Rogers, who had previously been instructor at the University of Iowa and the University of Washington, and later assistant professor of civil engineering at Lafayette College, was appointed professor of hydraulics and irrigation engineering; Messrs. Glenn W. Holcomb and E. C. Mathews, both of whom had been instructors at the University of Michigan, were appointed instructors in civil engineering. Mr. L. E. Brigham, a graduate in civil engineering of the Colorado State College, who has had several years' experience in engineering and in educational work, was appointed instructor in civil engineering. Mr. E. D. Roberts, who has had eleven years' experience in railroad engineering, was appointed instructor in civil engineering.

At the beginning of the year, prior to the consolidation of the irrigation and civil engineering departments, the latter department was quartered on the second floor of Apperson Hall in a suite of rooms consisting of two drafting rooms, two class rooms, one office, and an instrument room. Such space was barely sufficient to care for the enrollment of civil engineering students. With the increased enrollment of that year in the department and with a corresponding increase in service courses, the quarters and equipment proved to be quite inadequate.

During the congested year of 1919–1920 the department made a thorough study of the housing and equipment problems. The results of this study were incorporated in a third floor, which was added to Apperson Hall, and in the equipment of the instrument room. The new third floor is occupied solely by the department of civil engineering and contains four suites, each of which consists of a drafting room, a class room, and an office, and two additional class rooms. Each suite is adequately equipped with drafting tables and other furniture.

The surveying equipment which is housed in a separate

building has been increased to 25 transits, 26 levels, 7 plane tables, 7 compasses, 9 sketching boards, 43 level and stadia rods, together with an adequate supply of tapes, pins, axes, line rods, barometers and other small hand equipment, all of which is of high-grade material so selected as to familiarize the student with the best American-made instruments.

The hydraulic laboratory equipment is housed in the central portion of the new engineering laboratory building and consists of storage tanks, adequate facilities for measuring the flow and pressure of water, and a variety of pumps and turbines.

The equipment of the department is incomplete in a few minor details but when funds become available these additions will be made.

The curriculum has been revised with the following principles in mind: (1) To present thoroughly and efficiently the basic principles of civil engineering. (2) To give a knowledge of business and English. (3) To supply training in those special phases of civil engineering in which most of the engineering problems of the state of Oregon lie. The subjects of the curriculum may be divided into four groups. The first includes applied mechanics, hydraulics, structures, hydraulic machinery and reclamation, in which 93½ credit hours are required; the second group includes the abstract and physical sciences in which 45 credits are required. The third, in which 32½ credit hours are required, includes English and business. A fourth group in which 32 credit hours are required is of a miscellaneous nature. This last group includes military, gymnasium and course subjects in other engineering departments.

The department sees in the not distant future that the present equipment and building will be outgrown and is looking forward to a new engineering building.

Pennsylvania State College.—The exercises in connection with the inauguration of Dr. John M. Thomas as president took place on October 13 and 14. On Thursday, the 13th,

there were a number of educational conferences devoted to subjects of interest in different branches of educational work. In the Engineering conference the following subjects were presented: "The Relation of the Technically Trained Man to the Promotion, Organization, and Development of Industry." by Mr. L. W. Wallace, Secretary, Federated American Engineering Eocieties, Washington, D. C.; "The Relation of the Technically Trained Man to Economy in Production and the Prevention of Waste," by Mr. Frank B. Gilberth, Montclair, N. J., and "The Relation of the Technical School to Industrial Research," by Mr. A. D. Flinn, National Research Council, New York, N. Y. In the evening there was a general convocation addressed by Governor William C. Sproul and Mr. Charles M. Schwab.

On Friday forenoon the main program began with a parade of the students of the college led by the cadet regiment, which was followed by a series of floats illustrating the work of the various departments. The formal inauguration ceremonies were held in the Schwab Auditorium. In his inaugural address Dr. Thomas outlined a program of development providing for the broadening of the scope of the institution and the change from a state college to a state university, which proposition seemed to meet with general approval.

In the evening the student celebration was held beginning with a mass meeting in the Schwab Auditorium and ending with "stunts" and fireworks on Beaver field.

Saturday was Alumni Home Coming Day and an unusually large number of alumni were in attendance, many of whom had improved the opportunity to be present at the inaugural exercises.

University of Porto Rico.—The Degetau Building destroyed by the earthquake and fire in the autumn of 1918, which has been rebuilt, was ready for occupancy at the opening of the school year.

Machinery has arrived for the steam and electrical labora-

tory and it is expected that the present legislature, which is now in session, will vote the necessary funds to construct a modern engineering building.

The new curriculum is better articulated with the high-school course of study. A more equitable arrangement of theory and practical work in the engineering department has been adopted.

A new course, that of architecture, will be offered next year.

Enrollment in the Schools of Engineering, Purdue University.

	Civil Engineering.	Mechanical Engineering.	Electrical Engineering.	Chemical Engineering.	Total.
Freshman year	120	185	218	87	610
Sophomore year	106	179	148	52	485
Junior year	100	162	111	56	429
Senior year	66	107	73	45	291
Special	5	19	8	1	33
Total	397	652	558	241	1,848
Resident graduates	2	4	1	1	
Non-resident graduates	6	5	4	–	

The Rensselaer Polytechnic Institute.—The total enrollment for this year is larger than 1920–1921 but the number of new men is less than that for last year.

There are several new men: Dr. A. W. Daveson becomes professor of physical chemistry. The new instructors are: Messrs. H. O. Sharp, H. B. Compton, W. E. Dewey and Dr. G. E. Lyon in civil engineering; Messrs. C. C. McRae, T. F. Fitz Gerald, W. C. Sutton and R. L. Wheeler in mechanical engineering; Messrs. R. F. Baurs, H. R. Mimeno, E. B. Rhodes and G. F. J. Tyne in electrical engineering and Messrs. H. Aduer, W. K. Egloff, H. A. Young in chemical engineering.

The mechanical engineering department is planning a conference on teaching methods in accordance with the suggestion of President Scott.

The mechanical engineering department has added aërodynamics to the course to replace marine engineering. They have recently purchased an oil engine operated on the Diesel principle. A new Kerr turbine is to be installed.

The Institute has used Professor Thurstone's questions to rate one hundred new freshmen.

The Institute has advanced classes to 8:30 to end work at 4:00 P.M. for purpose of having more daylight for physical exercise.

Rutgers College.—The new building now under construction for the ceramic engineering department at Rutgers College, State University of New Jersey, will be ready for occupancy by early spring. The building, 45 ft. × 102 ft., will include two stories and basement. The exterior, of Colonial design, is being constructed of light red brick with terra cotta trimmings. Laboratories and equipment for the manufacture, on a small scale, of ceramic products such as brick, porcelain, glass and enameled products will be provided. The furnace rooms and heavy products machinery laboratories will be in the basement. The ceramic materials, pottery machinery, and research laboratories will be on the first floor. The offices, library, chemical laboratories, drafting room and a ceramic museum will be located on the second floor.

The ceramic department at Rutgers College was established by the State of New Jersey in 1902 for the purpose of affording courses in ceramic instruction within the state and to promote through research work the development of the ceramic resources of the state. The department has always had the active support of the ceramic manufacturers of the state and substantial contributions of ceramic materials and money have been donated by them toward the erection and equipment of the new building. The research

activities of the department will be greatly extended when the new laboratories and equipment are available.

Rutgers feels fortunate in securing the services of Prof. George Winchester, Ph.D., who resumes teaching this fall after about four years of experimental work for the Air Service Division of the Army and Navy. Dr. Winchester comes as head of the department of physics. He served as acting head of the department of physics in the University of Washington 1906–07, and as head of the department of physics in Washington and Jefferson 1907–17. He has also done considerable teaching in his alma mater, the University of Chicago.

Stevens Institute of Technology.—One wing of the Navy Building, which was built by the U. S. Navy Department during the World War in connection with the Navy Steam Engineering School conducted at Stevens, was remodeled during the past summer and now houses the department of electrical engineering. New equipment is being added to bring the laboratory up to date and to take care of the increased enrollment. The laboratory has been laid out to accommodate efficiently sections of seventy-five to one hundred students at one time, which represents half of the Senior class expected for the next few years. Assistant Professor Stockwell has been advanced to the rank of associate professor of electrical engineering, and Mr. W. Palmer Powers, formerly in charge of the electrical laboratory work at Pratt Institute, has entered the same department with the rank of assistant professor.

Mr. Appuhn of the department of mathematics has been advanced to assistant professorship.

The lecture room vacated by the department of electrical engineering has been equipped as a model and sketching room for the use of the department of machine design in the mechanical drawing division, and the two offices vacated by the electrical department will be combined and equipped with a modern blue-printing outfit.

The two rooms used by the electrical department for laboratory work have been taken over by the department of physics; one of them is now in use in connection with sophomore experiments.

Professor C. B. LePage, assistant professor in the department of physics, has resigned to take up secretarial work in the general offices of the American Society of Mechanical Engineers.

A. and M. College of Texas.—A new course in agricultural engineering has been organized in the School of Engineering. This course does not displace the present course in agricultural engineering given to agricultural students but is built on a different foundation and has for its objective the training of men for occupations requiring an engineer with an agricultural bias.

Contract has been let for a modern engineering shops building, to replace the shops destroyed by fire during the past session. The building will be of modern fire-proof construction.

The following is a list of some of the new teachers in the School of Engineering: J. B. Straw, associate professor of electrical engineering, was formerly connected with the University of Pennsylvania, though for a few years past he has been doing engineering work.

Mr. E. W. Markle, assistant professor of electrical engineering, was chief instructor of the electrical department in one of the schools maintained by the E. & R. branch of the U. S. Army.

Mr. E. B. Paxton, instructor, was with the Westinghouse Elect. and Mfg. Co.

Mr. A. S. Legg received his B.S. degree at this institution and is now employed as an instructor.

In the department of chemistry the new instructors are:

W. T. Bryant, a former instructor here, who has been doing commercial chemical engineering work for several years.

E. L. Harter, a graduate of Colorado University.

B. C. Jones and J. B. Oliphant, both of whom received their B.S. degrees in chemical engineering here in June.

Mr. F. A. Burt, formerly associate professor of geology at Mississippi A. & M. College, has accepted a similar position here.

Toledo University is adding a new Science Hall containing rooms and apparatus planned with a view to most conveniently serve the needs of the science work of the university. It is a three-story, fire-proof structure, modern in all of its appointments, finished in oak with hardwood floors, and comparing favorably with other buildings of its kind. It is approximately 60 ft. $\times$ 200 ft., with wing 60 ft. $\times$ 150 ft. Provision is made for the departments of biology, chemistry, pharmacy, physics, psychology, and for the engineering laboratories, drafting rooms, class rooms, and shops.

Some work is now being carried on in the new building and it is expected that all of the departments will be completely moved and settled before the beginning of next semester.

OBITUARY.

Alexander Gray, director of the School of Electrical Engineering, Cornell University, died on October 13, after a prolonged illness. Professor Gray went to Cornell from McGill University, Montreal, in 1915. He was born in Edinburgh of a well-known family of engineers. As a boy of fifteen he was apprenticed and worked for seven years at the lathe, bench and drafting board, during which time he attended evening classes and later engineering classes at Edinburgh University. He was graduated from that institution in 1903 in civil and mechanical engineering. Subsequently the Whitworth scholarship, which enabled him to spend two years in the study of electrical engineering at McGill University, was awarded to him. He joined the engineering staff of the Bullock Electric Company, where he was head of the alternating-current motor department, and continued with the Allis-Chalmers Company after the merger. During the five years that he was thus occupied he attained a wide experience in the design, construction and operation of all types of electrical machinery. He went to McGill in 1910 as an assistant professor. A number of patents for electrical apparatus were granted to him and he also contributed largely to the literature of the industry. His two books, "Electrical Machine Design" and "Principles and Practice of Electrical Engineering," have been widely adopted as university textbooks. Professor Gray was a member of the Society for the Promotion of Engineering Education since 1915.

BOOK REVIEWS.

Advanced Shop Drawing. By VINCENT C. GEORGE, B.S., Instr. Mech. Eng., University of Wisconsin. McGraw-Hill Book Co. $1.60.

A brief treatise on working drawings, standard titles, bill of material, details of spin, bevel and worm gear shop drawings. Isometric, cabinet, shaded and patent office drawings are considered briefly, as are structural drawings, electrical drawings, drawings, plans for pipe systems, sheet metal developments. Numerous examples serve to illustrate some of the important problems met with in practice. The book treats the above subjects from a point of view that the reader is familiar with the elements of mechanical drawing and descriptive geometry. 137 illustrations, 147 pages.

W. F. W.

Analytical Geometry. By CLAUDE IRWIN PALMER AND WILLIAM CHARLES KRATHWOHL. McGraw-Hill. xiv + 347 pages. $2.50.

First Course in Analytical Geometry. By CHARLES N. SCHMALL. D. Van Nostrand Company. ix + 338 pages. Second Edition. $2.25.

In turning through these two books we notice that in the first of them numerical problems are used almost exclusively to be worked by the students along the lines of the theory developed in the text, while in the second book we find, in addition to the numerical problems, many original exercises which are theorems. It is needless to say that from this standpoint we can see that the former is written for the student who has less ability in mathematics than is required of the student who completes the second book successfully. Many times we are puzzled why the student of to-day shows

so very little ability to do real thinking in mathematics until we examine his text books on algebra and there we find that most of the problems are such as are designed to develope his technique, but there are comparatively few problems from which the student may secure training in the art of analyzing a situation, and by synthetic processes be able to build up statements written in symbolic language to which he may apply his technique. In the newer geometries we find many trivial exercises which have replaced many of the older originals. The students often tell us that in the secondary schools they were not required to give much attention to the few originals that remain.

It is easier to pass the students in our courses when we put before them problems which require only the most elementary types of thinking, but we can not expect, in this manner, to develope real ability in a student to do both of the things required of even an amateur mathematician—to handle the technique or tools of the subjects which he has so far studied, and to think on his own account, which should enable him to apply this technique to the problems of the world in so far as he has become acquainted with the world. Both of these aims must be kept steadily in view by the teacher, and he should recognize the fact that there is no other way to train his student than by real work on the part of that student. Both of these books under review surpass many of the works on the subject which have recently been published in clearness and in aim, and so we welcome them to our midst as representatives of the better class of text books.

F. A. F.

Economics of Bridge Work. By DR. J. A. L. WADDELL. 512 pages, 6″ × 9″. Cloth binding, $6.00. John Wiley & Sons, publishers.

The title suggests a book in keeping with the times. This valuable addition to engineering literature not only points

the way to higher efficiency in bridge building and maintenance, but will aid the profession in general, in meeting the rigid economic requirements of our post-war reconstruction period.

The author, with the aid of his able contributors, fully discusses the most efficient procedure with given types of structures. These discussions include: surveys, designing, detailing of shop drawings, fabrication, painting, transportation of materials, erection and maintenance, with liberal advice on the organization and management of each of the working units employed.

The compared economics of various materials of construction and various types of structures are interesting and valuable features of the book. In comparative economics, the following typical chapters may be mentioned: Alloy Steels, High-level and Low-level Crossings, Variation of Span Lengths, Steel and Reinforced Concrete Structures, Riveted and Pin Connected Bridges, Continuous and Non-continuous Trusses, Simple Trusses and Cantilever Bridges, Cantilever and Suspension Bridges, Various Types of Movable Spans, etc.

There are 45 chapters, carefully arranged in type of the usual size. The book contains a well-detailed table of contents, and an excellent index. Also lists of the 79 diagrams and the 26 tables.

J. H. S.

Highway Engineering. By GEORGE R. CHATBURN, A.M., C.E., Professor of Applied Mechanics and Machine Design and Lecturer on Highway Engineering, The University of Nebraska. 379 pages. $5\frac{1}{2}'' \times 8''$. John Wiley & Sons, Inc. A member of the Wiley Agricultural Series.

A text book intended primarily for students in agriculture, but because of its breadth useful as a reference work for highway engineers and road builders. The book has been made strictly up to date through the consultation of an un-

usually large number of references and contains a large volume of information in a very compact form. It contains an original method for calculation mixtures to conform to a predetermined sieve analysis curve, and tentative methods of the American Society of Testing Materials for testing sand clay mixture. The survey and location of roads is given in considerable detail, and a large number of photographs of highways in process of construction, road making machinery, etc., is included, adding considerably to the value of the work.

L. W. M.